Attorney Docket No. 0756-2011

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:	)	Group Art Unit: 2812
Shunpei YAMAZAKI et al.	)	Examiner: V. Simkovic
Serial No. 09/362,192	)	CERTIFICATE OF MAILING
Filed: July 28, 1999	)	I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as First Class Mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on _____.
For: SEMICONDUCTOR DEVICE HAVING SEMICONDUCTOR CIRCUIT COMPRISING SEMICONDUCTOR ELEMENT, AND METHOD FOR MANUFACTURING THE SAME	)	_____

SUBMISSION OF EXECUTED RULE 132 DECLARATION

Honorable Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Further to the Amendment filed on November 25, 2003, submitted herewith is an executed Rule 132 Declaration.

Respectfully submitted,

Eric J. Robinson
Reg. No. 38,285

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PMB 955
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DECLARATION UNDER 37 CFR § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I, Shunpei YAMAZAKI, declare as follows:

1. I obtained my Doctor of Engineering degree from Doshisha University in March, 1971; established Semiconductor Energy Laboratory Co., Ltd. (SEL) in 1980 and engaged in the research and development of amorphous silicon solar cells as president of SEL; and I have authored and co-authored over fourteen technical papers including four given at international conferences and have obtained hundreds of patents in the United States and abroad.

2. As a named inventor in the above-captioned application, I have reviewed the *Office Action* dated June 25, 2003, and the rejection of the claims asserted therein.

Specifically, I am aware that claims 45, 47, 60, 62 and 67-72 are rejected therein as obvious based on the combination of U.S. Patent No. 5,858,819 to Miyasaka and U.S. Patent No. 5,851,860 to Makita et al., and claims 46, 49, 50, 52-54, 56-58, 61 and 64-66 as obvious based on the combination of Miyasaka '819, Makita and U.S. Patent No. 6,066,516 to Miyasaka and I have reviewed these patents. I have also reviewed the *Response* to be filed by *Certificate of Mailing* on November 25, 2003 and the arguments presented therein.

3. Independent claims 45, 49, 52, 56, 60 and 64 of the subject application each recite providing a material for promoting crystallization (or at least one metal element) to at least a part of a semiconductor film formed over a substrate, subjecting the semiconductor film to plasma, and crystallizing the semiconductor film after subjecting the semiconductor film to the plasma to obtain a crystalline semiconductor film (claims 45, 52 and 60) or irradiating the semiconductor film after subjecting the semiconductor film to the plasma with one of an infrared ray and a laser light (claims 49, 56 and 64).

4. I understand that the *Office Action* dated June 25, 2003, concedes that "Miyasaka also fails to teach ... the step of contacting a material for promoting crystallization to at least part of the semiconducting film formed over the substrate" (page 2, Paper No. 28). I also understand that *Office Action* asserts "[such] a step is well known and is taught by Makita" and that "[it] would have been obvious to one of ordinary skill in the art at the time of the invention to combine this step with the step of using oxygen plasma, as the use of a metal catalyst to promote crystallization is well known, and one of ordinary skill in the art would [have] known that combining such two steps, each of which enhances crystallization, together, would further improve the overall level of crystallization" (pages 2-3, Id.).

5. I have observed with an optical microscope a semiconductor film crystallized using a metal element (nickel) without subjecting the semiconductor film to oxygen plasma. Using this process, I have observed that the size of crystal grains is

relatively large. The sampl is formed by the steps of depositing an amorphous silicon film having a thickness of 690 Å over a quartz substrate by LPCVD, applying a solution containing nickel to the amorphous silicon film by spin coating and crystallizing the amorphous film by heating at 600°C for 12 hours after applying the solution containing nickel.

6. In accordance with my invention, I have observed with an optical microscope a semiconductor film crystallized using a metal element (nickel) after subjecting the semiconductor film to oxygen plasma. Using this process, I have observed that the size of crystal grains is relatively small as compared to the process described above. The sample is formed by the steps of depositing an amorphous silicon film having a thickness of 600 Å over a quartz substrate by LPCVD, subjecting oxygen plasma to the amorphous silicon film, applying a solution containing nickel to the amorphous silicon film by spin coating after subjecting oxygen plasma and crystallizing the amorphous silicon film by heating at 600°C for 12 hours after applying the solution containing nickel.

7. As noted above, I have observed that the grain size of the semiconductor film in the first process is much larger than in the second process using oxygen plasma. While the electrical characteristics of the TFTs can be generally improved by increasing the grain size, the uniformity of the electrical characteristics among the TFTs tends to become worse if the grain size is large. This is because the electrical characteristics tend to depend upon the existence of grain boundaries in the channel region. If the grain size is large, the number of grain boundaries existing in the channel region is small but the TFT properties vary more apparently depending upon the existence of the grain boundaries. On the other hand, if the grain size is relatively small, the number of grain boundaries in the channel region can be averaged so that the TFT properties do not so vary.

8. I have found that the combination of the use of oxygen plasma along with a metal for promoting crystallization produces a synergistic effect in that the oxygen

plasma promotes uniform and homogenous crystallization while the catalyst promotes a crystal with a small number of defects and continuous grain boundaries. I have found that the present invention has an unexpected advantage of promoting crystallization by the use of a metal for promoting crystallization while improving the uniformity of TFTs.

9. The undersigned Declarant declares further that all statements made herein of his own knowledge are true and that all statements made in information and believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 or Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

12/26/2003
DATE

SHUNPEI YAMAZAKI